
APPLICATION OF GEOGRAPHIC INFORMATION SYSTEM IN FLOOD CONTROL AT YOLDE
PATE, YOLA ADAMAWA STATE

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Abstract

Geographic information system a computer based tool for mapping and analysis was used to determine the flood risk zone in Yolde Pate. A base map made from a topographical map of the study area. From the base map created, the digital elevation model (DEM) was generated by digitizing on the screen the contour lines. An appropriate, module of the ILWIS software was used to interpolate for immediate value of the digitized contour lines. The overall result of coverage (map) which is a digital elevation model (DEM) of the study area was made. From the study carried out and the analysis of the result obtained, it has been clearly revealed that the flood risk (prone) coverage in Yolde Pate is about 47.89% of the entire study area and only 40.04% is less potential to flooding while 12.07% is moderate good. Based on these results, appropriate recommendations are made that will assists the policy makers to make a sound decision on how to deal with situation in this area.

Keywords: Flooding, DEM, GIS, ILWIS

Introduction

Since the beginning of life, man has always been in constant confrontation with his environment and its attribute. These attributes are on one hand beneficial to man, socially and economically, and on the other, disastrous. This brings about the question of man's constant encounter and battle against environmental hazards which poses a threat to his very existence. These environmental hazards that are often affected to man include: drought desert encroachment, erosion, flood and so on.

However, water though a very helpful and important environmental element sometimes turns to be agent of destruction through floods. Flooding occurs when the discharged of a river cannot be accommodated within the margins of its boundary so that water exceed the carrying capacity of rivers. A flood causes extensive property damage amounting to millions of naira annually, in addition to loss of human live in Nigeria. The greatest loss of lives and property, on this planet are attributable to floods (Chorley, 1999).

Yolde Pate Area suffers annual flooding, leading to problems associated with environmental degradation, such as soil erosion and damage to the ecology and environment at large. The floods also damage agricultural products. Threat to health such as out-breaks of cholera, malaria and typhoid fever and other related diseases as a result of stagnant water and pollution of the sources of drinking water occur in the area.

An Overview of Flood Hazard and Geographical Information System

An attempt is made to review related literature on the causes, effects and hazards associated with flooding. The application of geographic information system in identifying and mapping flood – prone areas was also studied. Floods occur as a result of the inadequacy of the river channel, or lake to accommodate discharges from the rivers catchments areas thereby, causing inundation to its riparian area. It is unexpected rise in water level that causes water overflows its natural or artificial bank unto normally a dry land. Flooding is therefore seen as an overflow or runoff of water due to heavy downpour leading to streams and or dams overflowing their banks. The overflow often extends to adjoining farms, human settlements and other important areas of the environment not normally submerged. The consequence is damage to the environment or whatever that is found on it.

Causes of Floods

- i. **Heavy Rain Fall:** Heavy rain fall raises the water level. When the water level is higher than the river bank or the dams, the water comes out from the river, then we have flood. The water then runs off the land or is absorbed by it and hence remains a part of the hydrologic cycle. The total amount of water on earth remains constant despite the change of seasons. The hydrologic cycles are the evaporation of water from the oceans into the

atmosphere from which it falls as rain or snow on land (Isa, 2011).

- ii. **Relief:** Flooding often occur in low land. This is because rivers flow more slowly in low-lying area. If the water volume increases suddenly, floods occur.
- iii. **Deforestation:** Tree-cutting for the purpose of energy and building destroy the protective natures of soil. This occurs because;
 - No trees to absorb water, so more water flow into rivers.
 - No trees to compact the soil together, so soil erosion take place. Large amount of soil are washed by rain into the river.
 - Because of siltation, riverbed became shallower. The water volume increases, the river cannot hold all the water and overflows its bank.
- iv. **Poor Farming practices:** Some farming practice can damage the vegetation cover, so the soil will be washed away easily washed away.
- v. **Poor Water Management:** When dams, are poorly constructed or maintained, they can easily collapse and these results in flooding. In Nigeria there are series of flooding that were caused by poor management of dams. In 2004, the Bakalori dam in Sokoto State busted and overflowed. Many Lives and properties were lost. Hadeja/Jama're dam busted in 2001 and flooded properties within the area destroyed. Poor management of Laddo dam in the Cameroon Republic led to severe flooding in the Benue River (Isa, 2011).
- vi. **Population Pressure:** certain farming practices such as over cultivation and overgrazing gives room for such erosion. Dependency on wood as a source of energy also contributes to flooding because cutting of woods leads to deforestation. This later leads to poor soil structure promotes flooding.

Effects of Flooding

The Upper Benue River Basin has dynamic overflow behaviors and this always posed a serious danger to lives and properties along the banks. Examples are Loko flood disasters in 1989, 1991 and 2004 in Adamawa State (Anyawu, 2007). There were caused by unalarmed release of water from laddo dam in the Cameroon. Generally, floods

can equally affect communities in the following ways:

I. Economic loss

Flooding cause injuries and even lost of lives. In some part of Nigeria, people have lost their lives as a result of flooding, and many were rendered homeless on many occasions (Isa, 2011).

II. Damage to transport facilities

Flooding leads to the damages of roads, collapse of bridges or traffic congestion, which may affect the daily transport operations. Flooding also damage farms land houses, etc.

III. Lost of Life

Flooding causes great damage to properties, victims may experience economic loss worth of millions of naira, and may be rendered homeless. The flood can generally affects anything that comes it way.

IV. Diseases

flooding usually bring infection diseases, such as pneumonic, dermatopathia, dysentery and common cold (type A)

Review of related literature Tsuchiya, (1979) explained that flood analysis can enable areas vulnerable to flood be predicted thereby giving rise to proper land use planning and hence reduction of flood disasters. Simulation of the temporal dynamic of flood event and analysis produces significant information needed for disaster planning and management (Geomer, 2006). Adewusi (1990) observed that, water erosion and flooding are not necessarily caused by heavy downpour. He asserted that they are as a result of rainfall and the blockage of the water way which necessitates water to fight for its normal course. Adewusi did not confine his study to urban flooding but went further to identify human activities such as bush burning for meat, of wood for fuel, clearing of land for infrastructural development.

Musa, (2001) pointed out that Benin City, the capital of Edo state in Nigeria, has always been encountering flooding which has makes it necessary for the government to spend 80% of the yearly allocation to flood control in the state.

Study Area

Yola is located between latitude 09⁰7' N to 09⁰ 13' North and longitude 12⁰17' E to 12⁰ 33' East of the Greenwich meridian.

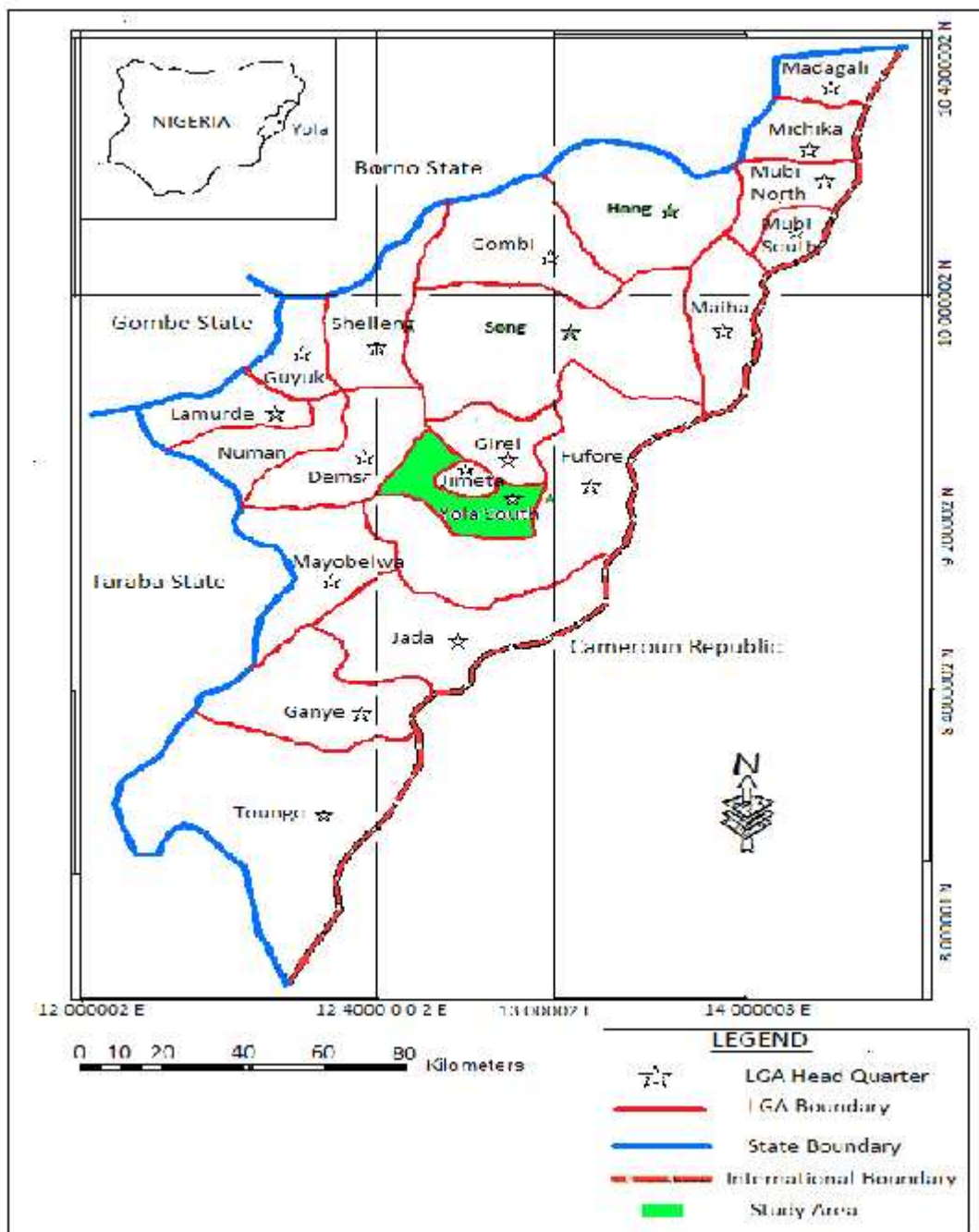


Figure 1: Map of Adamawa state showing Yola south L.G.A.

The study area is at the south west of Yola Town.
The area is drain by the river Karlahi and Chochi

River. River Karlahi is flowing to river Chochi
from the south west to the north east.

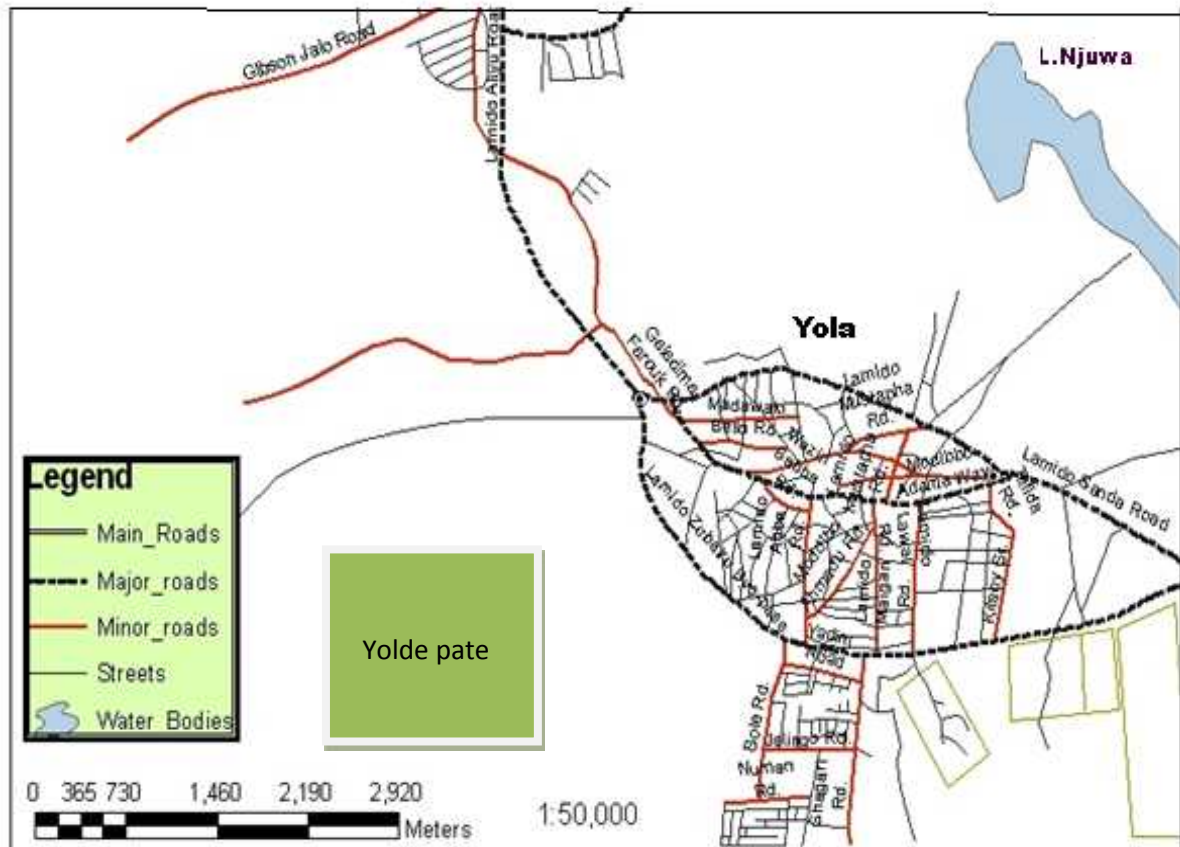


Figure 2: Map of Yola town showing study area (Yolde Pate)

Material and Method

Geographical information system (GIS) was utilized to map areas that are liable to flooding in Yolde Pate ward, Yola South Local Government area in Adamawa State. Methods adopted for the study include the field survey and office work, of which at the field researchers collected information on the flood, and analyzed the data in the office using the related soft wares as mentioned below.

Data Sources

The data used for the study were from two sources; primary and secondary sources. The primary sources include the coordinates of the identifiable points which were obtained at the site using GPS during inspection. The secondary source is obtained from the published information on the study area obtained from the State Ministry of Land and Survey, and Yola Local Government Council, respectively, regarding the flooding and human activities in the study area. Other related data were obtained through documented means found in Journals and textbooks.

I. Hardware and software

- **Hardware**
 - HP Laptop with 4 RAM and 320Hard Disk
 - LaserJet Printer
 - Scanning Machine
- **Software**
 - Operating System, Window 7
 - ILWIS Version 3.1 (A Raster – Based GIS Package)
 - CorelDraw (Version 12)
 - Arc View 3.2a

II. Creating a Base Map of the Study

The topographical maps were incorporated into the GIS within the ILWIS environment. The map was scanned into CorelDraw and export as TIFF (Tagged Image File Format) and then imported into the ILWIS environment. The various data types were incorporated into the Geographical Information System (GIS) by a computer equipped with GIS packages such as ILWIS; CorelDraw etc. the Topographical map of the study area was scanned, georeferenced and digitized. This became the base map of the study area.

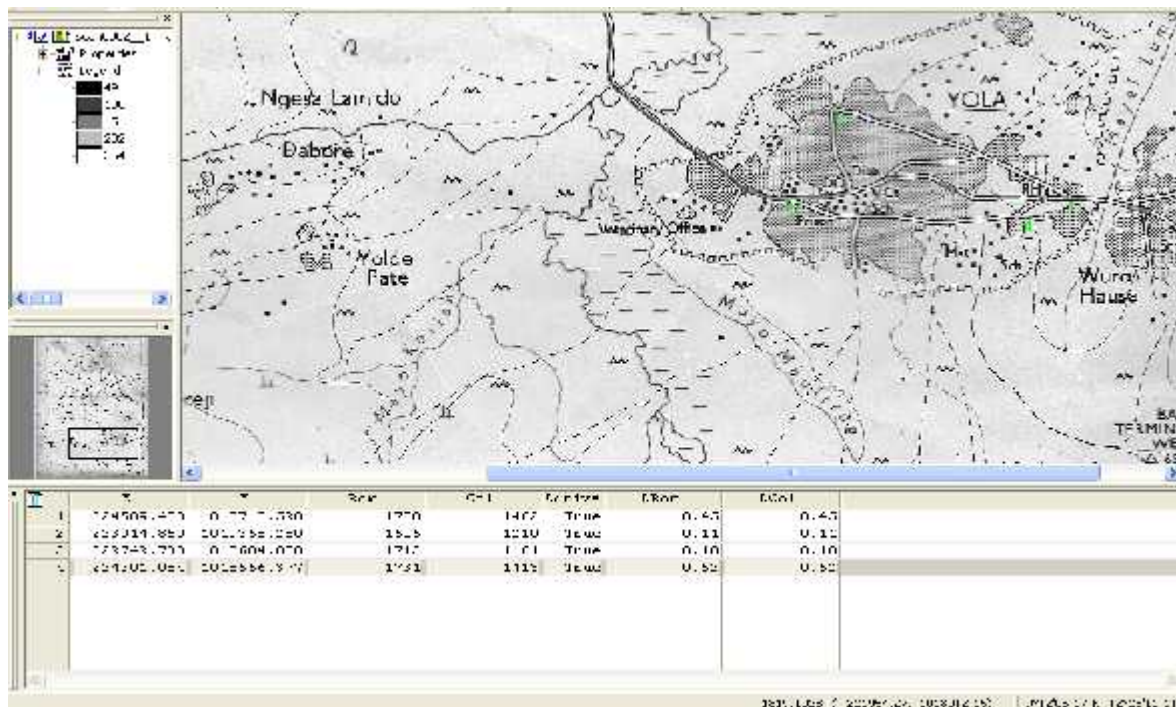


Figure 3: Georeference topographical map of Yola

Developing Digital Elevation Model

From the base map created, the digital elevation model (DEM) was generated by digitizing on the screen the contour lines by clicking the mouse on each of the contour lines on the base map and the values of each contour digitized was assigned as

provided on the Topographic map by its producer. An appropriate, module of the ILWIS software was used to interpolate for the intermediate values of the digitized contour lines. The overall result of coverage (map) which is a digital elevation model (DEM) of the study area was made. Fig.5

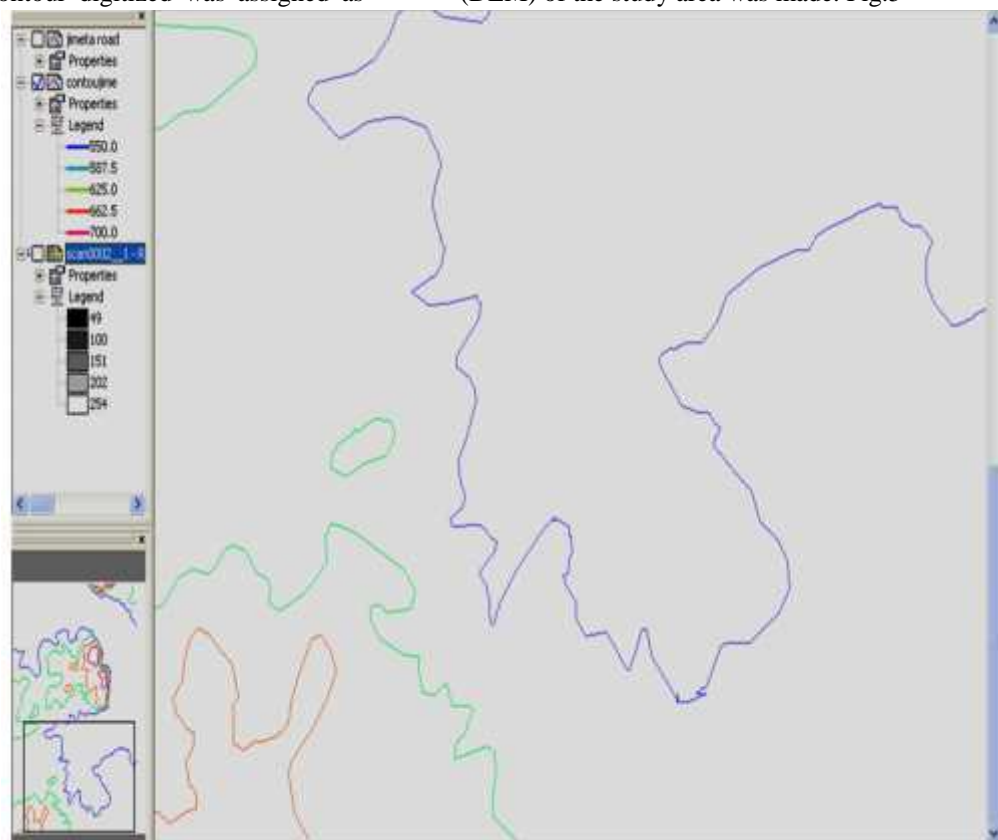


Figure 4: Contour map of study area

The contour map of the study area: the contour is digitized with the value domain i.e. each contour has its value and a color, from the legend on the left of the contour map. The value of each contour can be identify from it color, and the area with low

contour value are liable to flooding. Digital Elevation Model (DEM) of the study area was generated using ILWIS software in order to give a better appreciation and analysis. The results are presented in figures 5.

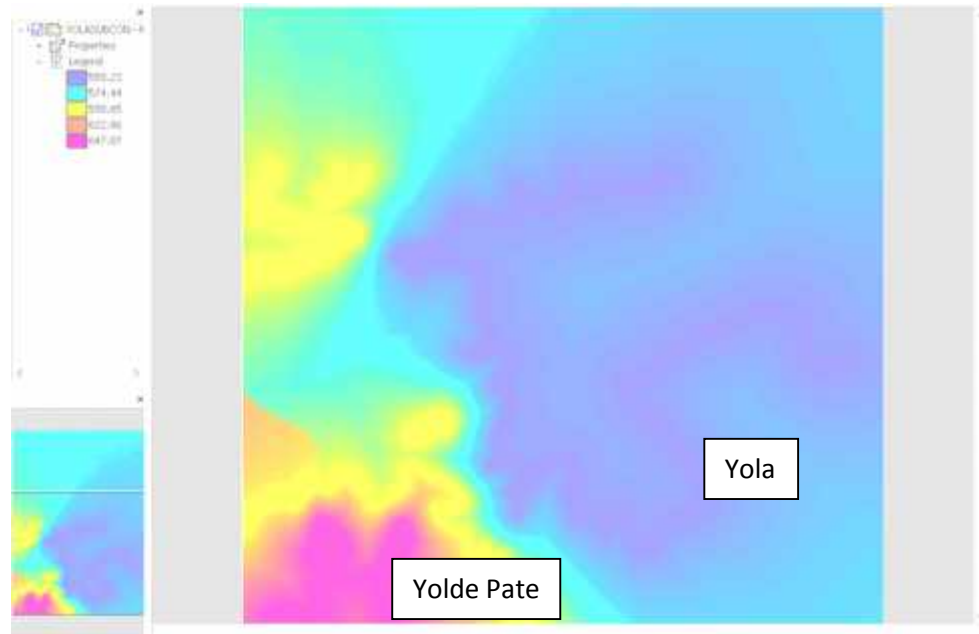


Figure 5: Digital Elevation Model of Study Area

Result and Discussion

Going by sampling look at the site, it was revealed that some places have been experiencing flooding annually. Such areas include; Dabore, Rumde mallum and Farm lands along river Mayo karlahi site. The areas with blue and green colors signify areas that are highly vulnerable to flooding, and areas with green color shows areas that are high to flooding. Also, the yellow color shows those that are moderately vulnerable to flooding, and orange

color shows a low area that are less vulnerable to flooding while pink areas that are not vulnerable to flooding. The very low flood risk zone was found around places like Gireije and in the southwest of yolde pate. From the study carried out and results obtained, it was revealed that the flood risk (prone) coverage in Yolde pate is about 45.8% of the entire study area, and only 32.0% is less potential to flooding while 22.2% is moderately. Fig 6

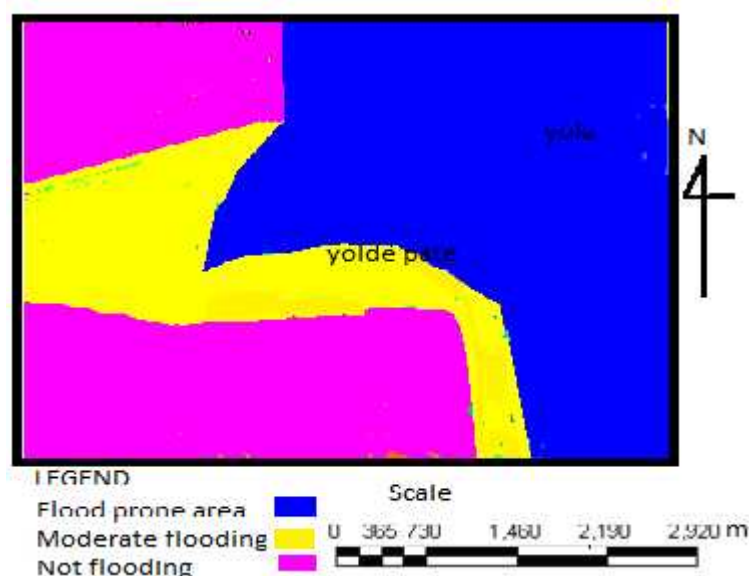


Figure 6: The Flood map of Yolde Pate

Conclusions

Yolde Pate has been a focal point in agricultural farming, and a fertile area for all seasonal crops; where rice planting, maize, and vegetables are harvested in commercial quantity. However, the area has been affected by flooding for quite a number of times leading to a setback of socio-economic development in the area. It is hoped that G.I.S, mapped hazard prone areas will help to mitigate flood hazards if the inhabitants could apply the result. An analysis to that effect could be beneficial to policy makers who could provide direction to future land development.

Recommendation

From the foregoing discussion, one realizes the urgent need to introduce some feasible measures to ameliorate flood damage bearing in mind the interest of the people. The Yolde Pate flood occurs as a result of the overflow of the river bank to the flood plain areas and affects the inhabitants annually. The people of Yolde Pate have tried their best to avoid the flooding but the floods persist. Although, the State and local government have made effort to resettle the people of Yolde Pate Town, there is a need to take more remedial measures on the flooding problem

Based on the effectiveness of the flood risk zone coverage, government has to provide and ensure proper land use by prohibiting any further development activities within the high and very high flood risk zones. The efficiency of the land use regulation can help to mitigate flooding, but that depends on the effectiveness of the regulation. Since Geographical Information System has the capability of zoning the flood risk areas, development planning, prediction of future flooding intensities and occurrence, planners and government policy makers should intensify their efforts in flood mitigation based on GIS predictive output.

However, these measures cannot be achieved if planners, policy makers or government do not implement the use of GIS Technology. Therefore, it is necessary for the government to implement the use of GIS techniques which allows a better understanding of terrestrial processes and human activities so as to improve economic vitality and environmental quality.

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